

the Gardens it would go straight to a pond, plunge boldly into the water and commence swimming; it swam slowly, but with facility and determination.

Colour. Iris dark brown; naked portion of face—♀ flesh-coloured; ♂ flesh-coloured, except the space between the eyes and the proboscis, which are purplish brown. Ears particoloured, black and flesh-coloured. Hands, feet, and ischial callosities black.

Hair, ♀. Reddish brown, bright chestnut on the top of the head, neck, and shoulders; underneath of head, neck, and body pale buff; a conspicuous white patch on the lower part of the back, forming a transverse diamond-shaped mark; tail white, the extreme tip being reddish buff.

Hair, ♂ (jr.). Much brighter coloured than the adult ♀. The upper parts are very bright yellowish chestnut, darkest on the top of the head; the lower parts are silvery buff; an irregular grey patch on the lower part of the back; tail silvery white at the base, gradually turning to brownish grey towards the tip.

Eyebrows, basal third red-brown, remainder black.

Hairs on the lips white.

Measurements.

	♀.		♂ juv.	
	in.	mm.	in.	mm.
Length, head and body	22	559	19	482
" tail (without end hair).....	24½	616	18	457
" " (with " ").....	25½	648	18½	470
Fore limb	19¼	489	14½	368
Hind limb	21¼	540	16½	419
Girth beneath arms	13	330	8	203
Ear	1¼	32	1¼	32
Projecting portion of nose.....	1	25	¾	20
Hind foot.....	7½	184	6	152

3. On the Temperature of the Ratite Birds.

By ALEXANDER SUTHERLAND, M.A.

[Received May 17, 1899.]

There is a large and fascinating chapter in the history of animal development which remains to be written, and lies as yet practically untouched. It is the story of the process by which the cold-blooded animals grew to be warm-blooded: or, to speak more definitely, it is the story of that adaption of the vaso-motor nerves and their centre in the medulla whereby, from a simple apparatus to regulate the flow of blood in the body to the parts where it happened to be needed, the whole system took on the more complicated function of regulating the temperature and keeping it at a high level most favourable to the animal's activity.

Before the story of that process can be written, many preliminary

years of observation will be necessary, and much gathering of facts such as, to a certain extent, Dr. Pembury has collected in the paper contributed by him to Schaefer's 'Physiology.' These will no doubt give an ultimate foundation for a satisfactory theory, which is as yet impossible.

Among these preliminary facts there must be many observations of the normal temperature of all species of animals, but more particularly of those birds and mammals which form the link between their own classes and the reptile class below them. Out in Australia, and under favourable conditions, I made, during two years, daily observations on the temperatures of monotremes and marsupials, and was able to show, in a paper published last year in 'Nature,' that those Orders which are structurally lowest, and therefore lowest in classification, are also lowest in temperature of all the mammals and form indubitably a chain of connecting-links between the cold-blooded and the warm-blooded condition. It is clear that up to a certain point increasing temperature has been a concomitant, perhaps a factor of general progress. Not, however, that the highest animal will always necessarily be the highest in temperature. Because, after a certain limit has been reached, progress is rather shown in perfecting the apparatus that secures a uniformity of temperature. For to all animals there is a limit beyond which it is fatal to go. A frog will begin to collapse at 32° C. (90° F.). A man is normal at 37° , but begins to collapse at 41° , and is beyond the hope of recovery if his temperature reaches 42° ($107^{\circ}\cdot6$ F.). Birds in general are normal about 42° , but perish at 45° (113° F.).

The process of development, therefore, is to carry an animal up to that temperature at which its metabolism will produce the most healthful activity, and, after that, to make the animal secure against dangerous variations from that standard. This process finds its perfection in man, who can sit with little inconvenience for an hour or two in an oven, where the heat would be such as to kill a rabbit in ten minutes.

Up to a certain point, however, the temperature of animals is closely concomitant with their rank in the zoological classification. The monotremes are the coldest-blooded of all mammals and the least able to maintain a uniform temperature, the lower genus, *Ornithorhynchus*, being also the less gifted in these respects. The other genus, *Echidna*, leads us a step higher and forms a link towards the lowest marsupials, among which family after family carries us steadily up to the characteristic mammalian temperature.

Having in a general way ascertained that this is the case with mammals, I was very anxious to do the same with birds, but have never had a chance until the Society's Gardens placed it in my way. Although the Apteryx, which structurally is the lowest of birds, is a native of New Zealand, I have never seen one in Australia on which to make observations. But on visiting London I received from Mr. Selater and Mr. Bartlett courteous permission and a generous co-operation in taking the temperatures

of the three specimens now in the Gardens, and I wish to place on record in the 'Proceedings' of the Society that the Apteryx is the lowest in temperature of all birds, so far as yet has been recorded.

The following were the rectal readings :—

Mantell's Apteryx, male,	37°·4.
" " young male,	38°·2.
Haast's Apteryx, male,	38°·1.

The average is 37°·9 C. (100°·2 F.).

Next to the Apteryx in rank comes the Order Casuarii, comprising the Emus and the Cassowaries. Of the former I secured the temperature some years ago in Melbourne, through the kind assistance of my friend Mr. Ernest Le Souëf. The two specimens on which observations were made stood at almost the same level, 39° C. (102°·2 F.). I was very anxious to see how the temperature of the Cassowaries compared with this. The Hon. Walter Rothschild very readily and cordially granted me permission to make observations on three specimens which belong to him in the Society's Gardens. The largest (*Casuaris intensus*), a species, I believe, newly named by Mr. Rothschild, showed a temperature of 38°·8 C. The bird of medium size (*C. beccarii*) was at 39°·2 C.; and the smallest, the specific name of which, on account of its immaturity, had not been determined, indicated 39°. The average of the three was 39° C. (102°·2 F.), which is identical with that of the Emu.

For the Order which stands next (Struthionæ), observations are as yet wanting, except two on the Ostrich, which are inconsistent and, as I think, not to be relied on.

But I have been more interested in going a step higher, out of the sub-class of the Ratitæ into the great sub-class of birds in general, called by Huxley the Carinatæ. The lowest order of the Carinatæ consists of the Crypturi, for which there existed no temperature records. By the courtesy of Mr. Bartlett, I was able to make observations on those in the Gardens and found a very decided step in advance.

Rufous Tinamou.	40°·8 C.
Spotted Tinamou.	39°·2 C.
" "	Another specimen. 41°·3 C.
" "	Third specimen. 41°·1 C.

These give an average of 40°·6 C. (105° F.), which brings them up to the lower limit of the range of temperatures usual for Anseres, Grallæ, and Gallinæ. For instance, in the case of fowls, I found that, over a long series of observation, their temperature, when they were lifted quietly off their perches by night, was on the average just at that level, 40°·6 C., but when lifted by day from the nests whereon they sat brooding their temperature averaged 41°·7 C. (107° F.).

There is another decided advance when we cross over among

the great orders of small and excessively active birds. The Passeriformes and Fringilliformes, with their allied orders, have an average temperature ranging from 42° to 44°.

Setting forth these results in a descending series, we find that:—

- (1) The higher birds range about 43° C. (109°·4 F.).
- (2) The middle birds range about 41° C. (105°·8 F.).
- (3) The lowest birds range about 39° C. (102°·2 F.).

But these observations in the Society's Gardens show that Apterix, the lowest order of all, is still lower in temperature, being only about 38° (100° F.).

The temperatures of the birds were all taken under uniform conditions, while the temperature of the air was between 55° and 63° F. And the result seems to bear out the contention, otherwise very probable, that the higher the bird in the zoological scale the higher in general is the temperature of its blood.

4. On the American Spade-foot (*Scaphiopus solitarius* Holbrook). By G. A. BOULENGER, F.R.S.

[Received May 25, 1899.]

(Plate LII.)

Remarks recently made by Dr. T. Gill¹ on the position of *Scaphiopus* in the family *Pelobatidae* have induced me to make a detailed examination of the typical species of this genus, the osteological characters of which have not been fully described before. I was all the better prepared for this task, having had an opportunity of keeping and observing some living specimens, for which I am indebted to my friend Mr. A. Pam. These have enabled me to exhibit some figures of the animal carefully drawn and painted from life by Mr. P. Smit (see Plate LIII.), the figures previously given by Holbrook and by Duméril and Bibron being very unsatisfactory and taken from spirit-specimens. I had at my command a good supply of the latter, as well as two prepared skeletons; but of the eggs and larvæ nothing was at hand, nor did literature afford any information on this head. I had applied last summer to Messrs. Brimley, in North Carolina, where the Spade-foot is abundant, who kindly informed me that the eggs are laid early in spring, in strings resembling those of toads, but thicker and with the vitelline spheres more irregularly disposed—in fact, as I infer, not unlike those of *Pelobates*. They added that the season was then too far advanced for tadpoles to be procured, as their development is comparatively rapid, and the pools in which they are reared dry up by the end of spring. I have therefore to postpone a description of the tadpole, which I hope, however, to supply ere long.

¹ Science, (2) viii. 1898, p. 935.